Notes on Spiny Lobster Larvae in the North Atlantic

Harold W. Sims, Jr.

Various species of Palinuridae, spiny lobsters, and Scyllaridae, sand lobsters, are found throughout tropical and subtropical areas of the world as well as in certain areas warmed by tropical currents. Although adult migrations may be extensive, they tend to follow the coast and deeper water seems to form a barrier to adult distribution. Widespread distribution of the species is largely accounted for by the dispersal of pelagic larvae by ocean currents.

The phyllosoma, leaf-like and transparent, is well adapted to a planktonic existence. The long larval life is well established by Smith (1948); Lewis (1951); Johnson (1960) and many others. Their wide geographic distribution is shown by Gurney (1936); Smith (1948b) and Thorson (1961, p. 468).

In the eastern Atlantic, adult spiny lobsters and sand lobsters range from as far south as southern Brazil, throughout the Caribbean, and as far north as Beaufort, North Carolina (Chace and Dumont, 1949; Moore, 1962). Larvae have been reported as far north as Bermuda by Lebour (1949). To my knowledge this paper constitutes the first report of phyllosoma larvae captured in the North Atlantic Current.

My report deals with a collection of phyllosoma larvae made by Dr. Rudolf S. Scheltema, of Woods Hole Oceanographic Institution. Collections were taken over a two year period from October 1962 to October 1964, during various cruises made between Woods Hole, Massachusetts and the Azores. Samples were taken using a 3/4 meter plankton net fished in an oblique or vertical manner from 200, 100, or 30 meters to surface. The time of each tow varied from 10 to 30 minutes. The samples were preserved in formaldehyde. The phyllosomes were later separated from other organisms and shipped to the author. Thirty-three phyllosomes of four genera were captured, the majority of them between 30-45° N. lat. and 72-64° W. long. However, live specimens were caught as far northeast as 30° 45′ N., 32° 05′ W. A list of stations yielding phyllosoma larvae is shown on Table 1. Taxonomic difficulties prevented identification beyond genus.

Of the four genera represented, *Panulirus* accounted for the largest number, 27. They ranged in size from 3.4-23.0 mm (Stages

TABLE 1

Station data for phyllosoma larvae captured in the North Atlantic

No.	Station	Location	Date	Time	Temp.	Tow	Gen.‡	Mm	Stage
1	Del 63-4-17	32°00′N 56°10′W	24V63	0945	22.1	0-100 m*	Pan.	12.2	7
2	Del 63-4-24A	37°15′N 70°57′W	4VI63	0800	22.5	0-100 m*	Pan.	3.4	3
3	Del 63-4-25	37°17′N 67°25′W	5VI63	0930	25.2	0-100 m*	Pan.	5.2	5
4	AII-13-3	41°33′N 64°39′W	2IX64	2343	18.6	0-100 m†	Scy.	18.9	?
5	AII-13-5	41°30′N 60°13′W	4IX64	0007	21.2	0-200 m†	Sc.	10.5	Last
6	AII-13-40	39°45′N 32°05′W	26IX64	1212	20.9	0-200 m†	Parr.	7.4	6
7	AII-13-45	39°34′N 42°41′W	29IX64	1104	23.5	0-200 m†	Pan.	8.3	6
8	AII-13-46	39°30′N 43°45′W	29IX64	2228	23.1	0-200 m†	Pan.	9.0	Damaged
9	AII-13-48	39°19′N 47°52′W	30IX64	2232	23.5	0-200 m†	Pan.	10.0	7
10	AII-13-50	39°37′N 52°00′W	1X64	2122	20.6	0-200 m†	Pan.	8.2	7
11	AII-13-51	39°49′N 54°42′W	2X64	1110	25.5	0-200 m†	Pan.	6.8	6
							Pan.	8.6	7
12	AII-12-2	36°22′N 67°53′W	23VIII64	1905	——	0-200 m†	Pan.	8.3	7
							Pan.	10.3	7
							Pan.	7.5	6
							Pan.	6.8	6
13	AII-1-9	33°52′N 71°25′W	2III64	0925	18.9	0-200 m†	Pan.	23.0	10
							Pan.	12.0	7
							Pan.	10.0	7
14	A284-5K	36°15′N 68°06′W	7IX62	2004	——	Surface	Parr.	22.9	9
							Pan.	6.5	6
15	A284-1G	39°40′N 70°40′W	6IX62	0240	——	0-100 m†	Pan.	8.9	7
							Pan.	8.3	7
							Parr.	8.9	6

TABLE 1 (cont.)

Station data for phyllosoma larvae captured in the North Atlantic

No.	Station	Location	Date	Time	Temp.	Tow	Gen.‡	Mm	Stage
16	A284-6K	36°16′N 68°06′W	7IX62	2023	——	0-100 m†	Pan.	12.2	7
							Pan.	8.5	6
17	A284-10KG	38°17′N 69°36′W	8IX62	——	——	0-30 m† 10 minutes	Scy.	5.1	?
18	A284-7K	36°16′N 68°06′W	7IX62	2105	——	0-30 m†	Pan.	8.7	7
							Pan.	8.7	7
							Pan.	7.5	6
							Pan.	7.6	6
							Pan.	12.2	8
19	A-1933-S-6	29°48′N 65°14′W	11VIII63	0034	——	0-30 m†	Pan.	6.9	6

*Vertical

†Oblique

‡Genera: Pan., *Panulirus;* Parr., *Parribacus;* Sc., *Scyllarus;* Scy., *Scyllarides*

3-10 according to Lewis, 1951). Sims and Ingle (1966) extended the size range for Lewis's stages of *Panulirus* larvae. Even these maxima were extended in each stage by larvae caught in the North Atlantic.

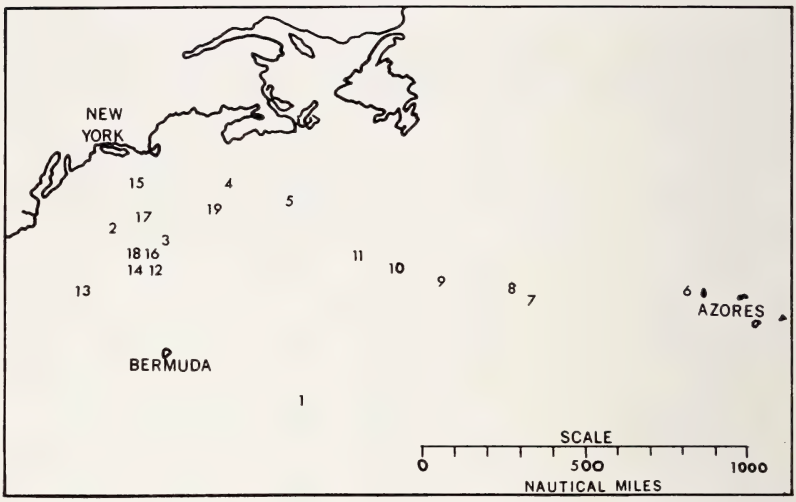

Fig. 1. Location of North Atlantic stations which produced phyllosoma larvae.

The water temperature, at time of sampling, averaged 10 degrees centigrade lower than the average temperature in which southern larvae were collected. The lower temperature may in some manner bring about larger sizes for the various stages. There is a possibility that some of these larvae belong to the species *Panulirus guttatus* which is common in Bermuda and may have larger phyllosoma stages. There are no published data on morphological differences between the larvae of *P. argus* and *P. guttatus* and attempts to separate Caribbean collections meristically have not been successful.

One stage 6, 8.3 mm larva of *Panulirus* was collected at Station AII-13-45, which is 2100 nautical miles from the known northern range of the genus. This apparent dispersal distance is consistent with previous estimates made by Ingle et al. (1963).

One phyllosome, genus *Scyllarus*, was captured at Station AII-13-5, about 600 miles due east of Cape Cod. The larva appeared

to be in the last or close to the last stage. There are no published data on the complete phyllosoma stages of the scyllarids and to place this larva into a species is impossible at this time. Adult *Scyllarus americanus*, *S. chacei*, and *S. nearctus* are reported to occur as far north as North Carolina (Holthuis, 1960).

The genus *Scyllarides* was represented by two specimens. One from Station AII-13-3, 400 miles east of Cape Cod and another from Station A284-10KG, about 300 miles east of Cape May Light. Holthuis (1946) reports the adult of *Scyllarides americanus* (*nodifer*) *and S. guineensis* var. *bermudensis* from Bermuda. The larvae of these species have not been described. The phyllosome from Station AII is larger and unlike other *Scyllarides* larva I have examined. The fore-body is as wide as long and twice as wide as the mid or hind-body which are formed as one. The antennae are flat and paddle-like composed of 2 segments. Antennule segments 4, with an endopod. The second maxilla is widely expanded in the shape of an anvil, but bears no setae. Maxilliped 1 is finger-like, extending behind the second maxilla. Maxillipeds 2 and 3 are typical, both lack exopods. Long coxal spines are found on the third maxilliped and on all pereiopods. Pereiopods 1-4 appear to be well developed, all bearing setose exopods. Most of pereiopods 3 and 4 are missing on this specimen. Pereiopod 5 is formed of 3 segments and is shorter than the tail. The uropods are formed as two pairs budding just forward of the telson which is formed of two long spines radiating at an acute angle. Four pairs of pleopods are formed on short stalks. The larva is without gills. A long spine projects upward on the dorsal carapace at the intersection of pereiopods 1-4. This larva is placed in the genus *Scyllarides* following the key suggested by Gurney (1936).

The second *Scyllarides* larva, collected at Station A284-10KG is similar to the larva in Gurney's Figure 26, p. 431.

Three specimens of the genus *Parribacus* were collected: one (7.4 mm, stage 6, at Station AII-13-10) just west of Flores in the Azores; one (22.9 mm, stage 9, at Station A284-5K) about 400 miles northeast of Cape Hatteras; and one (8.9 mm, stage 6, at Station A284-1G) about 1100 miles east of Atlantic City, New Jersey. The larvae were similar to ones I collected in the Yucatan and Florida Straits and fit well within the size ranges as shown in my descriptions of phyllosomes of *Parribacus* (Sims, 1965). Adults of *Parri-*

bacus antarcticus (Lund) are not reported north of Florida and there is no record of the species occurring in the Azores.

Discussion

In his interesting paper on species dispersion by ocean currents, Gunnar Thorson reiterates the fact that phyllosomes are truly long-distance larvae, drifting 90-120 days before settling. Consequently these larvae should be found in plankton far from the range of the adults. Studies in the Florida Straits showed that large numbers of phyllosomes are carried through the Yucatan Straits where they enter the Florida Current. As samples were taken northward in the current, fewer larvae were taken per tow. It is probable that some of them settle in Florida and Bahamian waters, and others are retained in the cyclic eddies that gyrate shoreward or into the Sargasso Sea. Some apparently are carried with the axis of the Gulf Stream into the North Atlantic where larval development is probably slowed as the water cools and great mortality must occur. It is evident, however, that some larvae can survive temperatures down to 18.6°C as was noted at Station AII-13-3.

Thorson (1961) states, "A surface current of average velocity will take some 22 to 23 weeks to pass from Cape Hatteras to the Azores." Guppy (1917) reports drift-bottles drifting 273 days to cover the same route. Although these figures may not be typical of normal current speeds the fact remains that a drift of this rate was recorded and it could be expected that a few isolated phyllosomes could be transported in the same manner. It is probable that the modal time is longer than that mentioned above. If so, all the young larvae collected east of Cape Hatteras probably originated from there or from Bermuda. Phyllosomes recruited from the Caribbean or Florida would probably be well into the last stages before reaching high latitudes; unless, of course, the lower temperatures slow larval development. If we use Thorson's figure of about 18 nautical miles a day, then a phyllosome hatched at Bermuda should be near the last stage by the time it reaches the Azores. The fact that early stages of the genus *Panulirus* were captured within 1000 miles of the Azores suggests that the larval life may be longer in these latitudes. There is always the possibility that deep water individuals produced the larvae we obtained, but there is no evidence to support this theory. It is not possible to evaluate an

Azores source since only a few adult samplings have been attempted there and these have been negative. The occurrence of a stage 6 *Parribacus* phyllosome, just west of Flores suggests that this genus occurs further north than Florida. A vigorous search for adult spiny lobsters in this area would be helpful.

LITERATURE CITED

CHACE, F. A., JR. AND W. H. DUMONT. 1949. Spiny lobster—identification, world distribution, and U. S. trade. Commercial Fish. Rev. U. S. Fish and Wildl. Ser., vol. 11, no. 5, pp. 1-12.

GUPPY, H. B. 1917. Plants, seeds and, currents in the West Indies and Azores. William Norgate, London.

GURNEY, R. 1936. Larvae of decapod crustacea. Discovery Reports, vol. 12, pp. 377-440.

HOLTHUIS, L. B. 1946. The decapod macrura of the Snellius Expedition. I. The Stenopodidae, Nephropsidae, Scyllaridae and Palinuridae. Biol. Res. Snellius Expdn. XIV, Temminckia 7, pp. 1-178.

HOLTHUIS, L. B. 1960. Preliminary description of one new genus, twelve new species, and three new subspecies of Scyllarid lobsters (Crustacea Decapoda Macrura). Proc. Biol. Soc. Washington., vol. 73, pp. 147-154.

INGLE, R. M., B. ELDRED, H. W. SIMS, JR. AND E. ELDRED. 1963. On the possible Caribbean origin of Florida's spiny lobster populations. Florida Bd. Cons. Tech. Ser., no. 40.

JOHNSON, M. V. 1960. Production and distribution of larvae of the spiny lobster, *Panulirus interruptus* (Randall) with records on *P. gracilis* Streets. Bull. Scripps Inst. Oceanogr. Univ. California, vol. 7, no. 6, pp. 369-379.

LEBOUR, M. V. 1950. Notes on some larval decapods (Crustacea) from Bermuda. Proc. Zool. Soc. London, vol. 1, no. 2, pp. 369-379.

LEWIS, J. B. 1951. The phyllosoma larvae of the spiny lobster *Panulirus argus*. Bull. Mar. Sci. Gulf and Carib., vol. 1, no. 2, pp. 89-103.

MOORE, D. R. 1962. Notes on the distribution of the spiny lobster *Panulirus* in Florida and the Gulf of Mexico. Crustaceana, vol. 3, no. 4, pp. 318-319.

Sheard, K. 1949. The marine crayfishes (spiny lobster), family Palinuridae, of Western Australia with particular reference to the fishery of the Western Australian crayfish (*Panulirus longipes*). Austral. Council Sci. Indust. Res., Bull. no. 247, pp. 1-45.

Sims, H. W., Jr. 1965. The phyllosoma larvae of *Parribacus*. Quart. Jour. Florida Acad. Sci., vol. 28, no. 2, pp. 142-172.

Sims, H. W., Jr. and R. M. Ingle. 1967. Caribbean recruitment of Florida's spiny lobster population. Quart. Jour. Florida Acad. Sci., vol. 29, pp. 207-242.

Smith, F. G. W. 1948a. The spiny lobster and scale-fish industry of British Honduras, with recommendations for its control and development. Rept. to the Government of British Honduras. Coral Gables, Florida, Mimeo., pp. 1-29.

——— 1948b. The spiny lobster industry of the Caribbean and Florida. Carib. Res. Coun. Carib. Comm. Port-of-Spain, Trinidad, Fish. Ser., no. 3, pp. 1-49.

Thorson, G. 1961. Length of pelagic larval life in marine bottom invertebrates as related to larval transport by ocean currents. *In* Oceanography, Amer. Assoc. Adv. Sci., Washington, D. C., pp. 455-474.

Marine Laboratory, Florida Board of Conservation, St. Petersburg, Florida. NFS Grants GB 2207 and BG 861; Florida Board of Conservation Contribution No. 110.